# Contents


**1 General Information About the Dräger Service Mode 3**

1.1 Definition of the Original Status ....3

1.2 Calibration Functions ....4

1.3 Reaction in the Event of a Technical Error (TE) ....4

1.4 Error Messages During a Specific Test ....5

1.4.1 Power Supply Low ....5

1.4.2 Pressure Low ....5

1.4.3 Pressure High ....5

1.4.4 Mode Switch Position (IPPV/CPAP) ....5

1.4.5 Mode Switch Position (IPPV/CPAP) ....5

1.5 Tests in the Dräger Service Mode ....6

**2 Starting / Exiting the Customer Service Mode (CSM) 7**

2.1 Test 001: Adjusting the Language ....8

2.2 Test 002: Testing the Gas Supply .... 10

2.3 Test 003: Position of the Pneumatic Switch (IPPV/CPAP) ....11

2.4 Test 004: Setting the Minute Volume Limits ....12

2.5 Test 005: Buzzer Test, LED Test, and LCD Test .... 13

2.6 Test 006: Adjusting and Reading Out the Potentiometers f, VT, Tinsp, and Pmax 14

2.7 Test 007: Tachypnea Monitoring Configuration .... 15

**3 Starting / Exiting the Extended Service Mode (ESM) 16**

3.1 Test 011: Calibrating the Pressure Sensors P-Supply and P-LA ....17

3.2 Test 012: Calibrating the Minute Volume Valve .... 18

3.3 Test 013: Adjusting and Displaying the Flow .... 20

3.4 Test 014: Reading in the Analog Channels .... 22

3.5 Test 015: Testing Basic Flow .... 26


GBR5673100SM1IVZ.fm
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## Contents

3.6 Test 016: Testing the Autozero Solenoid Valve ..... 28

3.7 Test 017: Displaying and Calibrating the Autozero Offset ..... 29

3.8 Test 018: Testing the Pressure Sensor Paw and Triggering the Minute Volume Valve 30

3.9 Test 019: Testing the Expiratory Solenoid Valve ..... 33

3.10 Test 020: Testing the ASB Solenoid Valve ..... 34

3.11 Test 021: Testing the Supply Pressure ..... 35

3.12 Test 022: Testing the Minute Volume Valve (Slow) ..... 36

3.13 Test 023: Testing the Minute Volume Valve (Fast) ..... 37

3.14 Test 024: Testing the Differential Pressure Sensor ΔP and Testing the Flow Measurement 38

3.15 Test 025: Testing the Pressure Switch PEEP-ASB ..... 40

**4 Technical Error (TE) List 41**

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# 1 General Information About the Dräger Service Mode

You can operate the Dräger Service Mode with the **Info** key and the **Reset** key. These keys allow you to change the set values, to scroll through tests, or to confirm execution of a specific test. The Dräger Service Mode is subdivided into the Customer Service Mode (CSM) and the Extended Service Mode (ESM). The working language used throughout the Dräger Service Mode is English.

The Dräger Service Mode in the MicroVent includes 20 tests:

- The first six tests (Test 001 through Test 006) are specifically designed for the customer (CSM), but can also be used by Dräger service technicians.
- The other fourteen tests (Test 011 through Test 024) are part of the Extended Service Mode (ESM) which is used to carry out calibrations. These tests are only accessible to Dräger service technicians. To do so, the Dräger service technician must enter a numeric code.

## 1.1 Definition of the Original Status

Each function in the Dräger Service Mode can be carried out separately. At the beginning of the Dräger Service Mode and after completion of a specific test, the MicroVent enters one of the following original status.

**Table 1: Original Status of the Micro Vent in the Dräger Service Mode**

| | |
|---|---|
| I:E solenoid valve | Off (expiration) |
| PN solenoid valve | Off (PEEP is inactive) |
| Autozero solenoid valve | Operated automatically |
| Exp. solenoid valve | Off (normal position = expiration) |
| ASB solenoid valve | Off (ASB is inactive) |
| MV valve | Closed |
| Alarm LED | Off |
| Buzzer | Off |
| LCD backlight | On |
| Paw alarm | Deactivate |

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## 1.2 Calibration Functions

The following table lists the four calibration functions available in the Dräger Service Mode. The data is stored in the EEPROM:

**Table 2: Calibration Functions in the Dräger Service Mode**

| No. | Function | Mode | Test No. |
|---|---|---|---|
| 1 | Adjusting the Language | CSM/ESM | 001 |
| 2 | Calibrating the Pressure Sensors (Pvers, PLA) | ESM | 011 |
| 3 | Calibrating the Minute Volume Valve | ESM | 012 |
| 4 | Calibrating the Autozero Offset | ESM | 017 |

**Caution:**

After installing a new Control PCB, perform the calibration functions (Nos. 1 through 4) specified in the table above.

After installing a new Sensor PCB, perform Test 011 “Calibrating the Pressure Sensors P-Supply and P-LA”.

## 1.3 Reaction in the Event of a Technical Error (TE)

If the MicroVent detects a technical error, it will show the error number on the display. The technical error and the name of the current test are displayed alternately at 2-second intervals. In the event of a technical error, all tests can be carried out normally. The message on the display disappears as soon as the technical error has been corrected.

A new Control PCB will generate the error No. 16 (invalid check sum in the EEPROM) before initial calibration. This technical error will disappear as soon as all data has been calibrated.

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## 1.4 Error Messages During a Specific Test

If the system detects and displays an error, you must confirm this error by pressing the **Info** key and the **Reset** key simultaneously. Once the error has been removed, the specific test can be selected and carried out again.

All potential errors and their cause are listed below:

### 1.4.1 Power Supply Low

| | |
|---|---|
| Problem<br>Accu/Bat. empty | No external power supply connected. The internal power supply is no longer sufficient for safe operation. |

### 1.4.2 Pressure Low

| | |
|---|---|
| Problem<br>Pressure low | Gas supply pressure is too low. |

### 1.4.3 Pressure High

| | |
|---|---|
| Problem<br>Pressure high | A gas supply source is connected although no pressure is required for this test. |

### 1.4.4 Mode Switch Position (IPPV/CPAP)

| | |
|---|---|
| Problem<br>Pos. IPPV/SIPPV | The mode switch is not in the correct position. |

### 1.4.5 Mode Switch Position (IPPV/CPAP)

| | |
|---|---|
| Problem<br>Pos. SIMV/CPAP | The mode switch is not in the correct position. |

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## 1.5 Tests in the Dräger Service Mode

**Table 3: Service Mode Tests**

| Test number | Test Name | Mode |
|---|---|---|
| 001 | Adjust language | CSM |
| 002 | Supply pressure | CSM |
| 003 | Mode switch | CSM |
| 004 | Adjust MV limits | CSM |
| 005 | Buzzer & LED test | CSM |
| 006 | Adjust f, $V_T$, Ti, Pmax | CSM |
| 007 | TACHYPNEA ALARM | CSM |
| 008 to 010 | Not assigned | |
| 011 | Calibration PSWI | ESM |
| 012 | Calibration MV valve | ESM |
| 013 | Flow set & measure | ESM |
| 014 | Analog inputs | ESM |
| 015 | Test basic flow | ESM |
| 016 | Test autozero valve | ESM |
| 017 | Autozero meas & cal. | ESM |
| 018 | Set MV valve, Paw | ESM |
| 019 | Test EXP valve | ESM |
| 020 | Test ASB valve | ESM |
| 021 | Test supply pressure | ESM |
| 022 | Test MV valve slow | ESM |
| 023 | Test MV valve fast | ESM |
| 024 | Flow measurement | ESM |
| 025 | Test pressure switch | ESM |
| 026-255 | Not assigned | |

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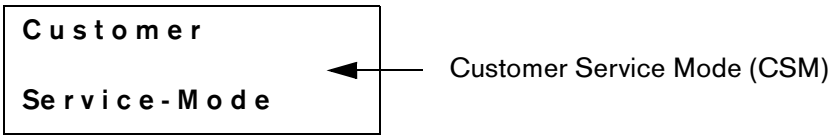
## 2 Starting / Exiting the Customer Service Mode (CSM)

**Important:**

In the Customer Service Mode (CSM), only Test 001 through Test 006 are accessible to the customer or Dräger service technician. The other tests are deactivated.
Test 007 is only available in US software version.

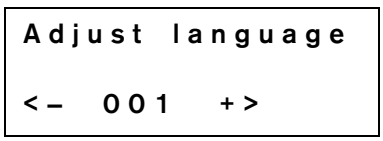
- Turn the potentiometers for frequency **f** and for tidal volume **VT** clockwise as far as they will go.
- Press and hold the **Info** key and the **Reset** key simultaneously and switch on the MicroVent.

**Display:**




- Release the two keys.

**Display:**




- Press the **Reset** key or the **Info** key to select Test 001 through Test 007.
- Press the **Reset** key and the **Info** key simultaneously to activate the respective test.
- Press the **Reset** key and the **Info** key simultaneously again to return to the Customer Service Mode (CSM).

**Exiting the Customer Service Mode (CSM)**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 2.1 Test 001: Adjusting the Language

This test allows you to adjust the language to be used during the MicroVent operation.

- Press the **Reset** key to select the desired language.

**Display:**

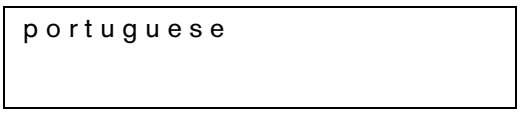
or

or

or

or

or

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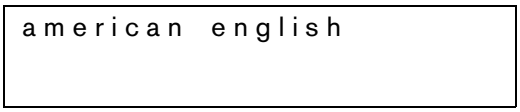
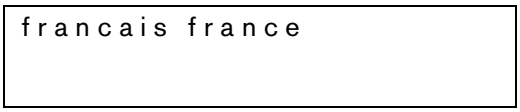
or

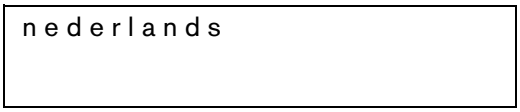
or




or




or




- Press the **Info** key and the **Reset** key simultaneously to adjust the desired language.

The MicroVent returns automatically to the Customer Service Mode (CSM).

### Exiting the Customer Service Mode (CSM)

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 2.2 Test 002: Testing the Gas Supply

The pressure sensors must have been calibrated (test 011 in Extended Service Mode) befre selecting test 002.

- Press the **Reset** key to select Test 002.
- Press the **Info** key and the **Reset** key simultaneously to activate Test 002.

**Display:**

| | |
|---|---|
| Pressure high | The gas supply pressure is sufficient. |

or

| | |
|---|---|
| Pressure low | The gas supply pressure is too low or the device is not connected to a gas supply source. |

- Press the **Info** key and the **Reset** key simultaneously to return to the Customer Service Mode (CSM).

**Exiting the Customer Service Mode (CSM)**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 2.3 Test 003: Position of the Pneumatic Switch (IPPV/CPAP)

This test allows you to check position of the IPPV/CPAP mode switch is checked. The respective position is shown on the MicroVent display. The pressure sensors must have been calibrated (test 011 in Extended Service Mode) befre selecting test 003.

If the pressure in the device is too low, or if the device is not connected to a gas supply source, the warning **"Problem pressure low"** will appear. The problem must then be rectified (establish gas supply) and subsequently confirmed with the Info and Reset key before test 003 can be called up again.

- Press the **Reset** key to select Test 003.
- Press the **Info** key and the **Reset** key simultaneously to activate Test 003.

**Display:**

| Pos. IPPV/SIPPV |
|---|

**or**

| Pos. SIMV/CPAP |
|---|

- Press the **Info** key and the **Reset** key simultaneously to return to the Customer Service Mode (CSM).

**Exiting the Customer Service Mode (CSM)**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 2.4 Test 004: Setting the Minute Volume Limits

This test allows you to check the settings of the minute-volume double-potentiometer (plausibility test).

- Press the **Reset** key to select Test 004.
- Press the **Info** key and the **Reset** key simultaneously to activate Test 004.

**Display:**

```
MV – low  = XX.XX

MV – high = XX.XX
```

- Adjust the values listed in the table below using the potentiometer and check the values shown on the display.

**Table 4: Minute Volume Alarm Limit Settings**

| Values Adjusted with the Potentiometer | | Values shown on the Display |
|---|---|---|
| MV - high | 2 L/min | 1.9 to 2.1 L/min |
| | 10 L/min | 9.5 to 10.5 L/min |
| | 20 L/min | 19 to 21 L/min |
| MV - low | 2 L/min | 1.9 to 2.1 L/min |
| | 10 L/min | 9.5 to 10.5 L/min |
| | 20 L/min | 19 to 21 L/min |

- Press the **Info** key and the **Reset** key simultaneously to return to the Customer Service Mode (CSM).

**Exiting the Customer Service Mode (CSM)**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 2.5 Test 005: Buzzer Test, LED Test, and LCD Test

This test allows you to check the audible and visible signals. The LEDs of the internal/external power supply, the alarm LED and the backlight of the display come on. The buzzer is activated and the pixels of the display are triggered.

- Press the **Reset** key to select Test 005.
- Press the **Info** key and the **Reset** key simultaneously to activate Test 005.

**Display:**

| | |
|---|---|
| INFO | TEST ON |
| RESET | TEST OFF |

- Press the **Info** key to start Test 005.
- Press the **Reset** key to stop Test 005.
- Press the **Info** key and the **Reset** key simultaneously to return to the Customer Service Mode (CSM).

**Exiting the Customer Service Mode (CSM)**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 2.6 Test 006: Adjusting and Reading Out the Potentiometers f, VT, Tinsp, and Pmax

This test allows you to compare the positions of the potentiometers f, VT, Tinsp and, Pmax with the values shown on the display.

- Press the **Reset** key to select Test 006.
- Press the **Info** key and the **Reset** key simultaneously to activate Test 006.
- Change the potentiometer settings for the frequency **f**, the tidal volume **VT**, the inspiratory time **Tinsp**, and the maximum pressure **Pmax** (see Table below).

The changed values are shown on the display.

**Display:**

| | |
|---|---|
| F = X X. XX | V T = X . X X X |
| T i = X . X | P = X X . X |

**Table 5: Potentiometer Settings: f, VT, Tinsp and Pmax**

| Settings on the MicroVent: | | Values on the Display |
|---|---|---|
| f | = 5 $min^{-1}$ | 5.00 to 5.13 $min^{-1}$ |
| | = 10 $min^{-1}$ | 9.88 to 10.17 $min^{-1}$ |
| | 60 $min^{-1}$ | 59.00 to 61.00 $min^{-1}$ |
| VT | = 0.1 L | 0.1 to 0.11 L |
| | = 0.8 L | 0.79 to 0.81 L |
| | 1.5 L | 1.48 to 1.50 L |
| $T_{insp}$ | = 0.2 s | 0.18 to 0.22 s |
| | = 1 s | 0.9 to 1.1 s |
| | = 3.0 s | 2.8 to 3.20 s |
| Pmax | = 20 mbar | 20.0 to 20.6 mbar |
| | = 40 mbar | 39.6 to 40.4 mbar |
| | = 60 mbar | 59.4 to 60.0 mbar |

- Press the **Info** key and the **Reset** key simultaneously to return to the Customer Service Mode (CSM).

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**Exiting the Customer Service Mode (CSM)**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

## 2.7 Test 007: Tachypnea Monitoring Configuration

This test is only available in the **US software version**. It enables the tachypnea monitoring to be activated and deactivated. An alarm is given if the patient exceeds a spontaneous breathing frequency of 30 $min.^{-1}$ over a period of 3 minutes.

- Press **Reset** key to select test 007.
- Simultaneously press **Info** and **Reset** keys to activate test 007.

Display:

| |
|---|
| T a c h y p m e a  a l a r m |
| I N A C T I V E |

- Press **Reset** key to activate alarm.

| |
|---|
| T a c h y p m e a  a l a r m |
| A C T I V E |

- Press **Info** key to deactivate alarm.

| |
|---|
| T a c h y p m e a  a l a r m |
| I N A C T I V E |

- Simultaneously press **Info** and **Reset** keys to return to Customer Servcie Mode (CSM)

Exit from Customer Servcie Mode

- Switching the MicroVent off and on again effects return to normal MicroVent operation.

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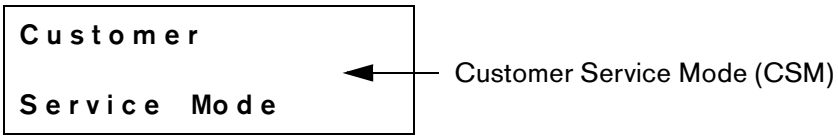
## 3 Starting / Exiting the Extended Service Mode (ESM)

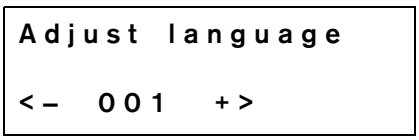
In addition to the tests in the Customer Service Mode (CSM) (Test 001 through 006), you have access to the fourteen tests in the Extended Service Mode (ESM) (Test 011 through Test 024). The remaining Tests 025 through 255 are not assigned. To start the Extended Service Mode (ESM), you must enter a specific numeric code.

- Turn the potentiometers for the frequency **f** and the tidal volume **VT** clockwise as far as they will go.
- Press and hold the **Info** key and the **Reset** key simultaneously and switch on the MicroVent.

**Display:**




- Release the **Info** key and the **Reset** key.




- Adjust the number “222” using the **Info** key or the **Reset** key.
- Press the **Info** key and the **Reset** key simultaneously for approx. 5 seconds to start the Extended Service Mode (ESM).

- Select the desired test with the **Info** key or the **Reset** key.
- Press the **Info** key and the **Reset** key simultaneously to activate the desired test.
- Press the **Info** key and the **Reset** key simultaneously again to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 3.1 Test 011: Calibrating the Pressure Sensors P-Supply and P-LA

This test allows you to calibrate the MicroVent pressure sensors. Proceed as follows:

- Disconnect the MicroVent from the gas supply.
- Adjust the mode switch to **IPPV**.
- Select the Extended Service Mode (ESM).
- Select Test 011.
- Activate Test 011.

**Display:**

```
Remove Pressure
```

- Simultaneously press **Info** and **Reset** keys to start calibration.

The pressure sensors are exposed to atmospheric pressure. The I:E valve switches over to inspiration and, at the same time, opens the minute volume valve. The Offsets of the pressure sensors are then stored in the EEPROM.

```
CALIBRATION

P_VERSP_LA
```

- As soon as the pressure has been decreased in the system, press the **Info** key and the **Reset** key simultaneously to store the calibration values.

The MicroVent returns automatically to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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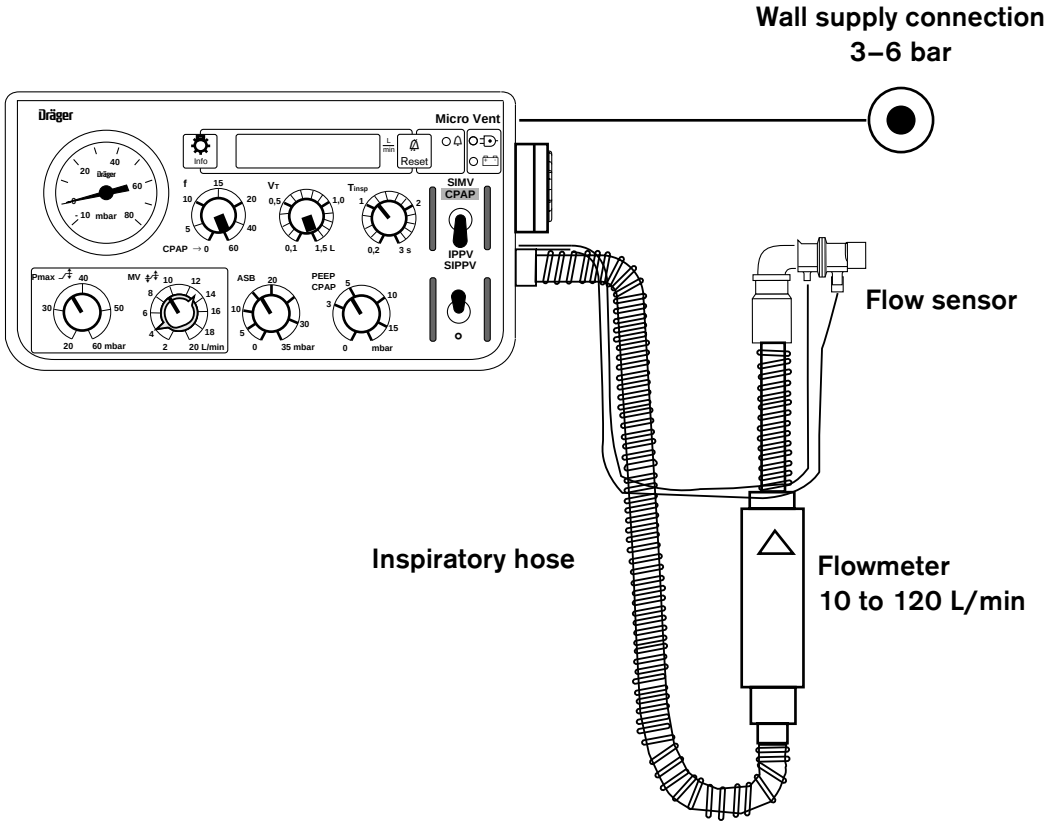
## 3.2 Test 012: Calibrating the Minute Volume Valve

During the calibration sequence (Test 012), you will be prompted to perform specific steps. The displayed flow value (Nom.) is the calibration point. At the beginning of calibration, the most recent stored flow value is adjusted. You can change this value by pressing the **Reset** key or the **Info** key. You cannot stop the calibration process, once it has started.

At each calibration point, the flow is to be adjusted by pressing the **Info** or **Reset** key such that the flow value displayed on the external flowmeter matches the corresponding flow value (Nom.) on the MicroVent display.

**Test Setup**




- Adjust the mode switch to **IPPV**.
- Adjust the rotary knob for PEEP/CPAP to 0 mbar
- Adjust the rotary knob for ASB to 0 mbar
- Select the Extended Service Mode (ESM).
- Select Test 012.
- Activate Test 012.

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**Important:**

Allow the MicroVent to stabilize at each calibration point. Watch the corresponding scale (Air or $O_2$) on the flowmeter.

**Display:**

```
Adjust PEEP=

0 mbar (cm H2O) !
```

- Simultaneously press **Info** and **Reset** keys to call up calibration point.

```
Nom.=XXL/min

ENTER=cal.Point
```

- If necessary, press the **Info** key or the **Reset** key to adjust the flow such that the value shown on the display matches that indicated on the external flow meter.
- Press the **Info** key and the **Reset** key simultaneously to store the points (see the following table) in the EEPROM.

| Calibration values | Tolerances of the set flow values | SW-Version |
|---|---|---|
| 10 L/min | 9.5 - 10.5 L/min | 1.10, 1.21 |
| 15 L/min | 14.5 - 15.5 L/min | 1.21 |
| 30 L/min | 29.4 - 30.6 L/min | 1.10, 1.21 |
| 50 L/min | 49.0 - 51.0 L/min | 1.10, 1.21 |
| 60 L/min | 58.8 - 61.2 L/min | 1.10 |
| 70 L/min * | 68.6 - 71.4 L/min | 1.10, 1.21 |

* If the calibration values (70 L/min) are not obtained, store the highest calibration values.

The last calibration point is calibrated and the MicroVent returns automatically to the Extended Service Mode (ESM)

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**Exiting the Extended Service Mode (ESM)**

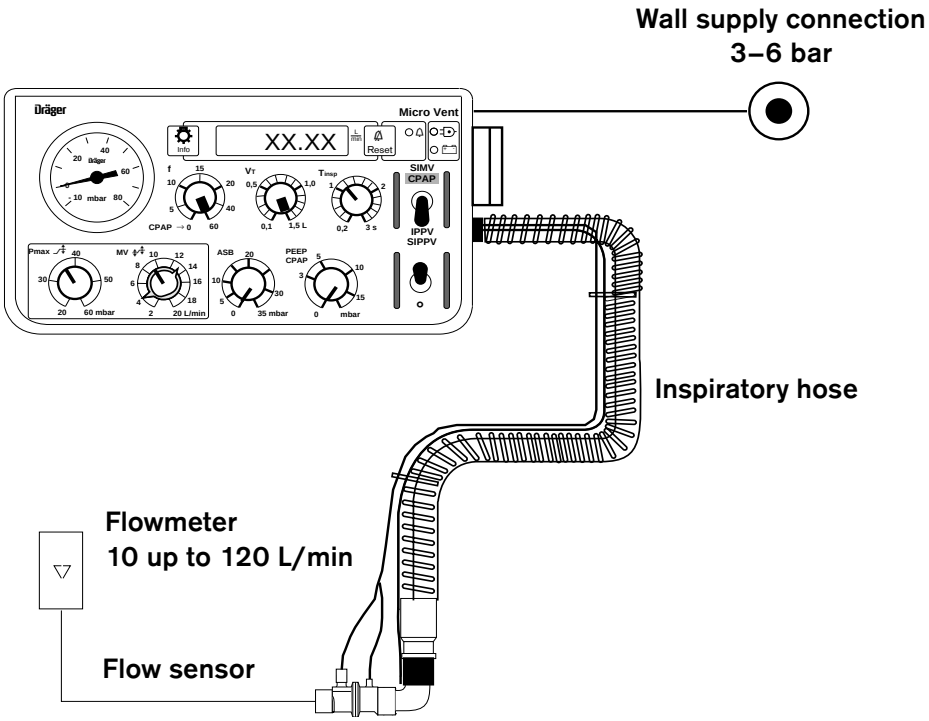
- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

## 3.3 Test 013: Adjusting and Displaying the Flow

This test allows you to adjust the flow in steps of 100 mL. The measured flow is continually displayed.

The I:E valve is switched on at the beginning of the test and switched off again at the end of the test.

**Test Setup**




- Adjust the mode switch to **IPPV**.
- Adjust the rotary knob for PEEP/CPAP to 0 mbar
- Adjust the rotary knob for ASB to 0 mbar
- Select the Extended Service Mode (ESM).
- Select Test 013.
- Activate Test 013.

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**Display:**

```
Nom. = XX.X L/min

Act. = +XX.X L/min
```

- Adjust the flow values (Nom.) with the **Info** key or the **Reset** key (see the following table) and check the display (Act.) on the MicroVent and with the external flowmeter.

**Table 6: Flow Settings**

| Adjusted flow (Nom.) | Flowmeter |
|---|---|
| 10 L/min | 9.0 to 11.0 L/min |
| 15 L/min | 14.0 to 16.0 L/min |
| 30 L/min | 27.6 to 32.4 L/min |
| 50 L/min | 46.0 to 54.0 L/min |
| 60 L/min | 55.2 to 64.8 L/min |
| 70 L/min | 64.4 to 75.6 L/min |

- Press the **Info** key and the **Reset** key simultaneously to finish Test 013.

The MicroVent automatically returns to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 3.4 Test 014: Reading in the Analog Channels

You can display the desired analog channel by pressing the **Info** key or the **Reset** key. The displayed measured value is continually re-calculated. A total of eighteen values are displayed. A total of eighteen values is displayed (1023 LSB correponds to 5.0 V).

- Select the Extended Service Mode (ESM).
- Select Test 014.
- Activate Test 014.

**Caution:**

The values shown in the following table apply to an operational MicroVent equipped with a fully charged and connected rechargeable battery pack.

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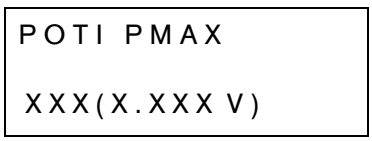
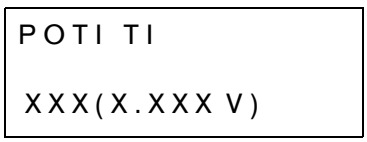
**Table 7: Designation of the Analog Channels**

| No. | Designation | Remark |
|---|---|---|
| 1 | Poti _Pmax | Front potentiometer, max. ventilation pressure. |
| 2 | Poti_Ti | Front potentiometer, inspiratory time. |
| 3 | Poti_VT | Front potentiometer, tidal volume. |
| 4 | Poti_f | Front potentiometer, frequency. |
| 5 | Poti MV | Potentiometer for definition of the MV valve's position. |
| 6 | P_ Flow | Differential pressure of the flow measurement. |
| 7 | Paw | Airway pressure. |
| 8 | Kontr_ VPSchalt | Switched 5 V voltage supply. |
| 9 | MV low | Front potentiometer, lower limit of minute volume. |
| 10 | MV high | Front potentiometer, upper limit of minute volume. |
| 11 | Kontr VBat | Rechargeable-battery or normal battery supply voltage. |
| 12 | Kontr Vext | External power supply. |
| 13 | Kontr VAlm | Power supply (batteries). |
| 14 | Kontr 5 V | Internal 5 V of power supply. |
| 15 | P_Versorgung | Supply pressure sensor. |
| 16 | P_Reserve | |
| 17 | P_LA | Lung demand valve pressure-supply sensor. |
| 18 | Akku Temp | Temperature-sensor rechargeable battery. |

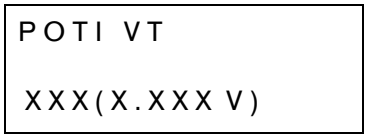
**Display:**




Left potentiometer stop: < 0.5 V
Right potentiometer stop: approx. 4.5–5.0




Left potentiometer stop: < 0.5 V
Right potentiometer stop: approx. 4.5–5.0




Left potentiometer stop: < 0.5 V
Right potentiometer stop: approx. 4.5–5.0

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| | |
|---|---|
| POTI F<br>XXX(X.XXX V) | Left potentiometer stop: < 0.5 V<br>Right potentiometer stop: approx. 4.5–5.0 |
| POTI MV<br>XXX(X.XXX V) | This value is calculated from the position of the MV valve. (This value isn´t defined). |
| P_FLOW<br>XXX(X.XXX V) | Unpressurized 2.5 V ±150 mV. |
| P_AW<br>XXX(X.XXX V) | Unpressurized 0.9 V ±0.1 V (offset). |
| KONTR. VPSCHALT<br>XXX(X.XXX V) | Supply voltage<br>5 V (tolerance: ±0.1 V) |
| MV_LOW<br>XX(X.XXX V) | Left potentiometer stop: < 0.5 V<br>Right potentiometer stop: approx. 4.5–5.0 |
| MV_HIGH<br>XXX(X.XXX V) | Left potentiometer stop: < 0.5 V<br>Right potentiometer stop: approx. 4.5–5.0 |
| KONTR_VBAT<br>XXX(X.XXX V) | Supply voltage<br>Internal NiCd battery (approx. 9 V) |
| KONTR_VEXT<br>XXX(X.XXX V) | Supply voltage<br>12 V (tolerance: ±1 V) |
| KONTR_VAIMN<br>XX(X.XXX V) | Supply voltage<br>5 V (tolerance: ±0.1 V)<br>Internal AlkMn batteries<br>**or**<br>< 1 V if Internal AlkMn battery pack isn´t installed. |
| KONTR_5V.<br>XXX(X.XXX V) | Monitoring<br>5 V (tolerance: ±0.25 V) |

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| |
|---|
| P _ V E R S O R GU N G<br><br>X X X ( X . X X X V ) |

Pressure sensor (P-supply):
(back pressure of the pressure regulator)

The indicated value **X.XXX V** corresponds to the calculated background of the pressure regulator (in volts).
Background = indicated value minus the offset (1 bar is equivalent to approx. 460 mV)

Offset = value indicated while the gas supply is disconnected

**Example:**

- Disconnect gas supply.
- Note the Offset-Value of the voltage (0.64 V).
- Connect gas supply.
- Note the measured value of the voltage (1.456 V).
- Formula:
  pressure result in Volt (1.456 V) – Offset value (0.64 V) = 0.816 V.
- Formula:
  0.816 V : 0.460 V (fixed value) <–> 1.773 bar (back pressure of the pressure regulator).

| | |
|---|---|
| P _ R E S E R V E<br><br>X X X ( X . X X X V ) | (not used in the Dräger Service Mode.) |
| P _ L A<br><br>X X X ( X . X X X V ) | Mode switch at position IPPV (< 2 V).<br>Mode switch at position SIMV (> 2 V). |
| A K K U _ T E M P<br><br>X X X ( X . X X X V ) | Rechargeable-battery temperature sensor (NTC)<br>Charging/temperature monitoring |

- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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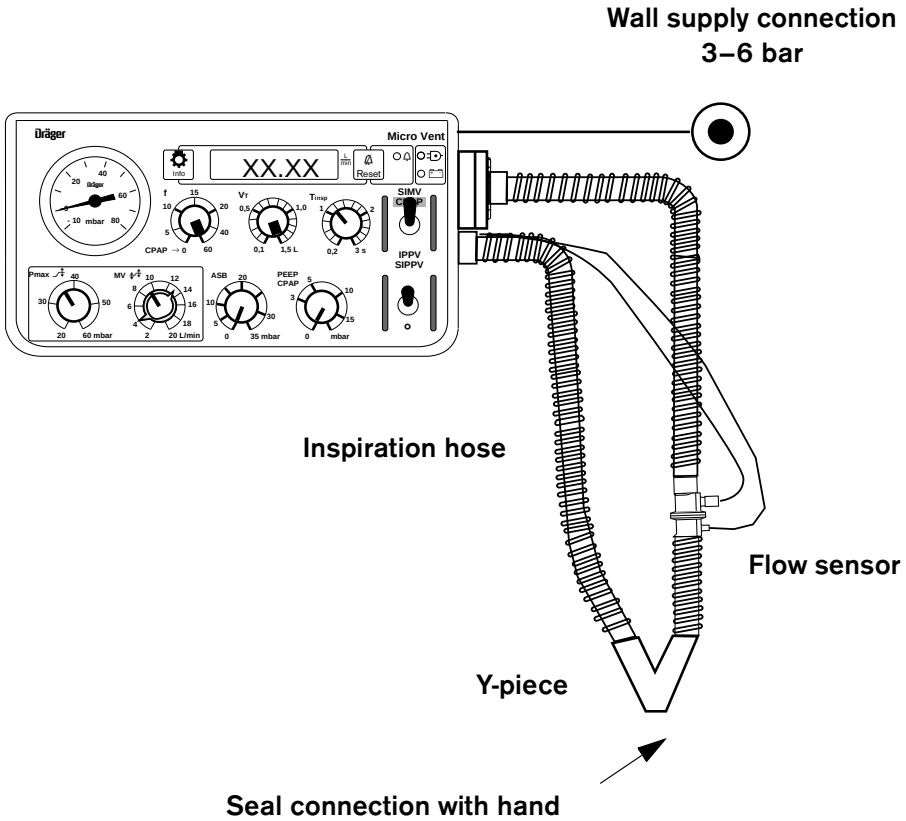
## 3.5 Test 015: Testing Basic Flow

The basic flow supplied by the fixed restrictor R4 is to be checked in switch setting IPPV/SIPPV.

The basic flow is fixed adjusted. It is measured continuously and displayed in the bottom line of the display. The basic flow should pass through the inspiratory hose, the expiratory hose and the ventilation valve. The desired value of the basic flow is shown in the top line of the display.

**Test Setup**




- Set the mode switch to **IPPV/SIPPV**.
- Adjust the rotary knob for PEEP/CPAP to 0 mbar
- Adjust the rotary knob for ASB to 0 mbar
- Select the Extended Service Mode (ESM).
- Select Test 015.
- Activate Test 015.

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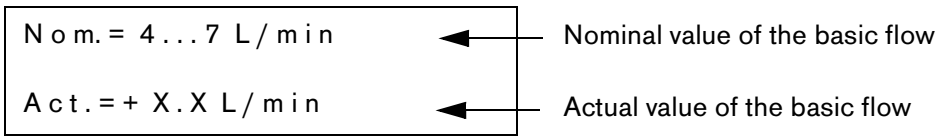
**Display:**




The basic flow should be 4 to 7 L/min.

- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

The following error message appears if the pneumatic switch is set to SIMV/CPAP.

| Problem:<br><br>Pos. SIMV/CPAP | Remedy: You must exit the test, remove the fault (by setting the mode switch to SIMV/CPAP), and restart the test. |
|---|---|

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## 3.6 Test 016: Testing the Autozero Solenoid Valve

This test allows you to check the function of the Autozero solenoid valve. You can hear the switching sound of the ASB solenoid valve. You can measure the valve voltage directly at the Autozero solenoid valve. It should be 6 V ±0.5 V. You do not need to connect the device to a gas supply to perform this test.

- Select the Extended Service Mode (ESM).
- Select Test 016.
- Activate Test 016.

**Display:**

| |
|---|
| INFO: Pos. ACTIVE |
| RESET: Pos INACT |

- Press the **Info** key to switch on the Autozero solenoid valve.

| |
|---|
| Pos. ACTIVE |
| RESET: Pos INACT |

- Press the **Reset** key to switch off the Autozero solenoid valve.

| |
|---|
| Pos. INACTIVE |
| INFO: Pos. ACTIVE |

- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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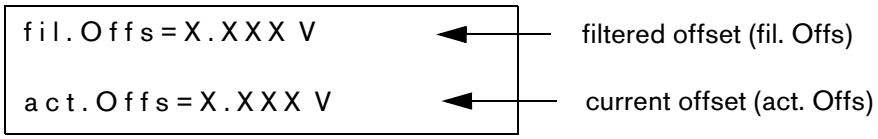
## 3.7 Test 017: Displaying and Calibrating the Autozero Offset

In the IPPV mode, the MicroVent ventilates the patient with the frequency (**f**), the tidal volume ($\mathbf{V_T}$), and the inspiratory time (**Tinsp**) values. The alarm messages are not active. The current offset (act. Offs) of the flow-measurement pressure sensor (Autozero) is displayed continually in the lower section of the display. The filtered offset (fil. Offs) is indicated in the top line of the display. The filtered offset compensates for the occurring fluctuations and has a greater stability. A new Autozero value is calculated at one to two minute intervals.

- Adjust the mode switch to **IPPV**.
- Select the Extended Service Mode (ESM).
- Select Test 017.
- Activate Test 017.

**Display:**




- Press the **Reset** key to calibrate the default offset (2.5 V).

The filtered offset (fil. Offs) and the current offset (act. Offs) have the same voltage value. The voltage should be approx. 2.5 V.

- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 3.8 Test 018: Testing the Pressure Sensor Paw and Triggering the Minute Volume Valve

No control of the minute capacity valve occurs in this test. If no key is pressed, the motor will stop. You can open or close the minute volume valve by pressing the **Info** key or the **Reset** key.

**Caution:**

The minute volume valve might get stuck. To avoid this, do not move the minute volume valve completely to its mechanical stops. Carefully open or close the minute volume valve.

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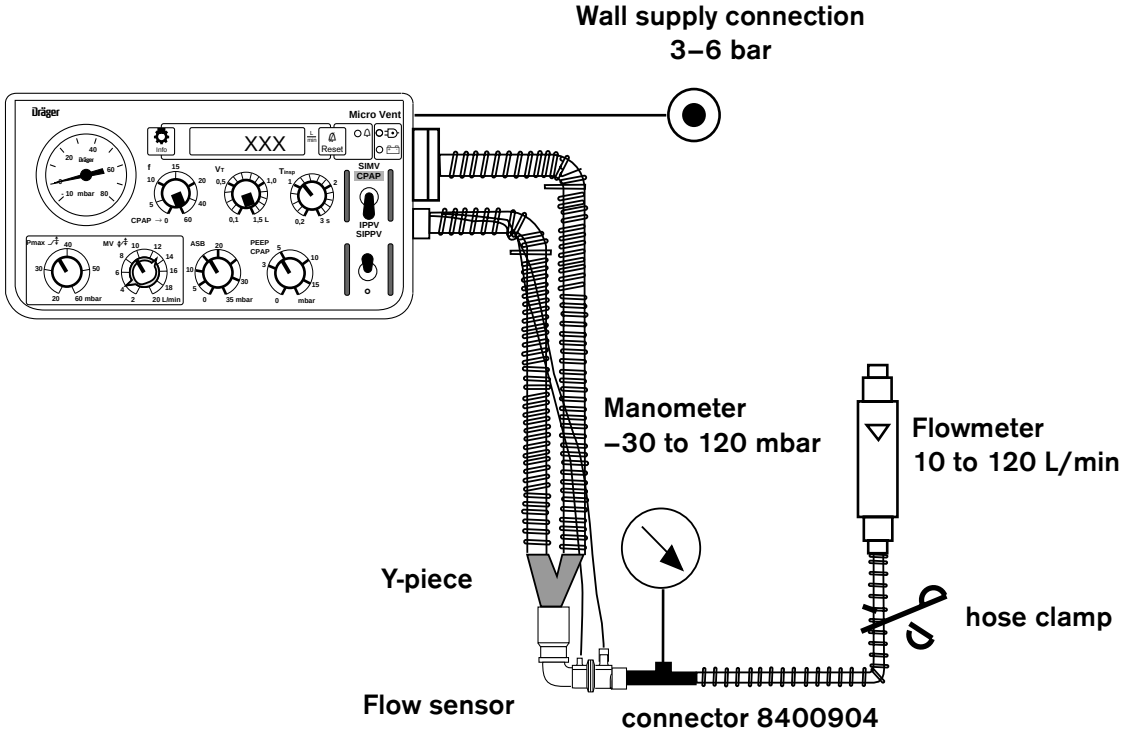
**Test Setup**




- Set the mode switch to **IPPV**.
- Adjust the rotary knob for PEEP/CPAP to 0 mbar
- Adjust the rotary knob for ASB to 0 mbar
- Select the Extended Service Mode (ESM).
- Select Test 018.
- Activate Test 018.

**Display:**

| |
|---|
| M V - P o t i = X X X X X |
| P a w = X X X m b a r |

Measured value of the Paw pressure sensor (mbar)

- Adjust a flow of 50 L/min with the **Reset** key.
- Adjust a pressure of 40 mbar via an external manometer using a hose clamp .

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The Micro Vent displays a ventilation pressure of 40 mbar ±2 mbar.

- Press the **Info** key or the **Reset** key to open or close the minute volume valve.
- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 3.9 Test 019: Testing the Expiratory Solenoid Valve

During this test, the expiratory valve can be switched on and off. Possible positions are: ASB or Normal. The switching action of the expiratory solenoid valve is audible. The valve voltage can be measured directly at the expiratory solenoid valve. The valve voltage should be 6 V ±0.5 V. You do not need to connect the MicroVent to a gas supply source in order to perform this test.

- Select the Extended Service Mode (ESM).
- Select Test 019.
- Activate Test 019.

**Display:**

```
INFO: Pos ASB

RESET:Pos NORMAL
```

- Press the **Info** key to switch on the expiratory solenoid valve.

**Display:**

```
Position ASB

RESET:Pos NORMAL
```

- Press the **Reset** key to switch off the expiratory solenoid valve.

**Display:**

```
Position NORMAL

INFO: Pos ASB
```

- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 3.10 Test 020: Testing the ASB Solenoid Valve

During this test, the ASB solenoid valve can be switched on and off. The switching action of the ASB solenoid valve is audible. The valve voltage can be measured directly at the ASB solenoid valve. The valve voltage should be 6 V ±0.5 V. You do not need to connect the MicroVent to a gas supply source in order to perform this test.

- Select the Extended Service Mode (ESM).
- Select Test 020.
- Activate Test 020.

**Display:**

| |
|---|
| I N F O :  Pos ACTIVE |
| R E S E T : Pos NOT AC |

- Press the **Info** key to switch on the ASB solenoid valve.

**Display:**

| |
|---|
| P o s  ACTIVE |
| R E S E T : ASB NOT AC |

- Press the **Reset** key to switch off the ASB solenoid valve.

**Display:**

| |
|---|
| Pos  NOT ACTIVE |
| INFO : A S B  ACTIVE |

- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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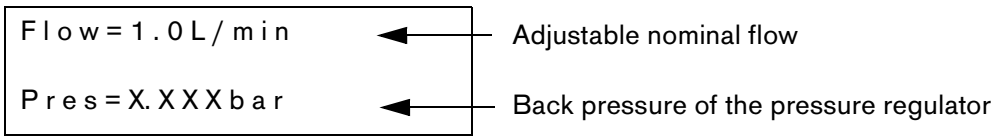
## 3.11 Test 021: Testing the Supply Pressure

During this test, the minute volume valve delivers an adjustable nominal flow. This nominal flow is indicated in the top line of the display. The specified flow can be adjusted in 100-mL steps using the **Info** key or the **Reset** key.

The pressure measured downstream of the pressure regulator is shown on the bottom line of the display. The influence of an increasing flow on the internal pressure is observable.

- Select the Extended Service Mode (ESM).
- Select Test 021.
- Activate Test 021.

**Display:**




- Press the **Reset** key and adjust a flow of 40 L/min.

The Micro Vent must display a value of approx. 1.6 bar (1.5 to 1.7 bar).

- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

**Important:**

Alarm message: Pressure low.

If the measured pressure falls below the alarm limit, the test is aborted and the alarm **Pressure low** is given.

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## 3.12 Test 022: Testing the Minute Volume Valve (Slow)

During this test, the minute volume valve control is switched off. The minute volume valve can be opened or closed **slowly** by hand.

**Caution:**

The minute volume valve might get stuck in the mechanical stop. To avoid this, do not move the minute volume valve completely to its mechanical stops. Open or close the minute volume valve carefully.

- Select the Extended Service Mode (ESM).
- Select Test 022.
- Activate Test 022.

**Display:**

```
INFO MV close
RESET MV open
```

- Press the **Info** key to slowly close the minute volume valve.
- Press the **Reset** key to slowly open the minute volume valve.
- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 3.13 Test 023: Testing the Minute Volume Valve (Fast)

During this test, the minute volume valve control is switched off. The minute volume valve can be opened or closed **fast** by hand.

**Caution:**

The minute volume valve might get stuck in the mechanical stop. To avoid this, do not move the minute volume valve completely to its mechanical stops. Open or close the minute volume valve carefully.

- Select the Extended Service Mode (ESM).
- Select Test 023.
- Activate Test 023.

**Display:**

```
INFO MV close

RESET MV open
```

- Press the **Info** key to fast close the minute volume valve.
- Press the **Reset** key to fast open the minute volume valve.
- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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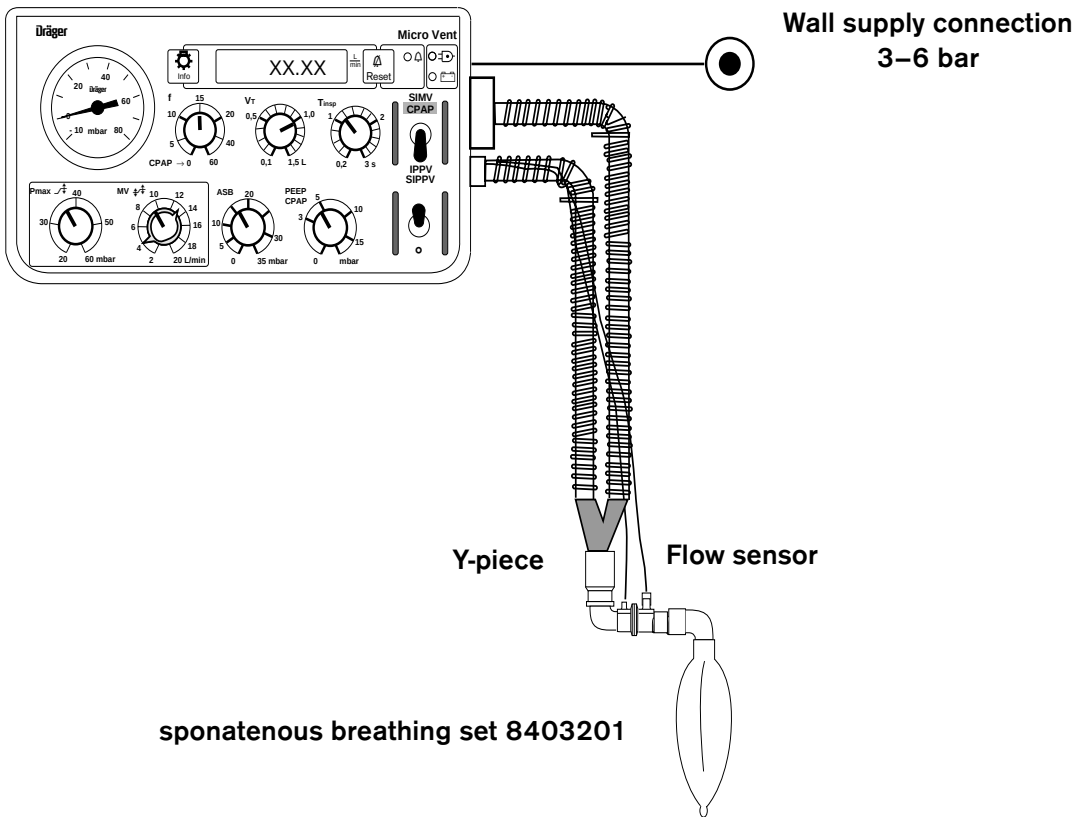
## 3.14 Test 024: Testing the Differential Pressure Sensor ΔP and Testing the Flow Measurement

This test allows you to adjust a simple ventilation pattern. No alarms are given during this test. You can toggle between the minute volume (Nom. and Act.) and the tidal volume (Insp and Exp) on the display.

### Test Setup




- Set the mode switch to **IPPV**.
- Select the Extended Service Mode (ESM).
- Select Test 024.
- Activate Test 024.
- Adjust the frequency to 15 $min^{-1}$ and the $V_T$ to 1 L/min.

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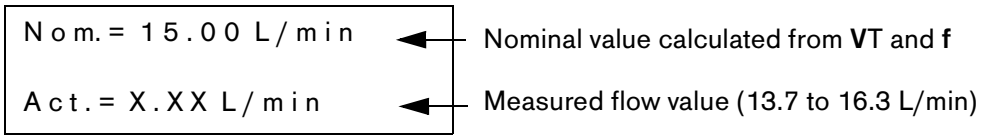
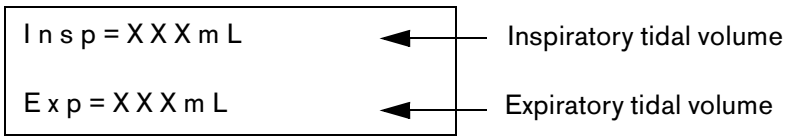
**Display:**




- Press the **Info** key to display the current tidal volume (the last applied respiratory stroke).

**Display:**




- Press the **Info** key and the **Reset** key simultaneously to return to the Extended Service Mode (ESM).

**Exiting the Extended Service Mode (ESM).**

- Switch the MicroVent off and on again to return to the MicroVent normal operating mode.

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## 3.15 Test 025: Testing the Pressure Switch PEEP-ASB

This test is only available from SW-Version 1.21. The digital signal (ON/OFF) of the pressure switch PEEP-ASB is shown on the display.

- Select the Extended Service Mode (ESM)
- Adjust the rotary knob for PEEP/CPAP to 10 mbar
- Adjust the rotary knob for ASB to 5 mbar
- Select Test 025
- Activate Test 015

Display:

| PRESS - SWITCH OFF |
|---|

- Adjust the rotary knob for ASB to 15 mbar

Display:

| PRESS - SWITCH ON |
|---|

- Press the INFO key and the RESET key simultaneously to return to the Extended Service Mode (ESM)

Exiting the Extended Service Mode (ESM)

- Switch the MicroVent off and on again to return the MicroVent normal operating mode.

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# 4 Technical Error (TE) List

**Table 8: Possible Errors in the Micro Vent**

| TE no. | Alarm | Cause | Remedy |
|---|---|---|---|
| 1 | A/D WANDLER TIMEOUT | Electronics | Replace electronics. |
| 2 | KONTR_5 V | Electronics | Replace electronics. |
| 3 | POTI MV high | Resistance outside range, cable harness | Check the cable harness and the connector. If necessary, replace the front panel. |
| 4 | POTI MV low | Resistance outside range, cable harness | Check the cable harness and the connector. If necessary, replace the front panel. |
| 5 | KONTR_VPSCHALT | Electronics | Replace electronics. |
| 6 | KONTR_VEXT | Incorrect ext. voltage | Check ext. voltage |
| 7 | TASTE_LCD_HG | Key sticks | Check, if necessary, replace the front plate |
| 8 | TASTE RESET | Key sticks | Check, if necessary, replace the front plate |
| 9 | BEIDE TASTEN | Key sticks | Check, if necessary, replace the front plate |
| 11 | POTI F | Resistance outside range, cable harness | Check the cable harness and the connector. If necessary, replace the front panel. |
| 12 | POTI VT | Resistance outside range, cable harness | Check the cable harness and the connector. If necessary, replace the front panel. |
| 13 | POTI Tinsp | Resistance outside range, cable harness | Check the cable harness and the connector. If necessary, replace the front panel. |

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**Table 8: Possible Errors in the Micro Vent**

| | | | |
|---|---|---|---|
| 14 | POTI_PMAX | Resistance outside range, cable harness | Check the cable harness and the connector. If necessary, replace the front panel. |
| 15 | EEPROM WRITE-ERROR | Electronics | Calibrate, otherwise replace electronics. |
| 16 | EEPROM CHECKSUMME | Electronics | Calibrate, otherwise replace electronics. |
| 17 | MV-VENTIL | MV valve sticks | Check, if necessary, replace the valve |
| 18 | POTI_MV | Tolerance | Check, if necessary, replace electronics. |
| 19 | SW WATCHDOG | EPROM, electronics | Replace EPROM or electronics. |
| 20 | IRAM | Electronics | Replace electronics. |
| 21 | XRAM | Electronics | Replace electronics. |
| 22 | EPROM | EPROM | Replace EPROM |
| 23 | EEPROM PTC FEHLER | EEPROM | Replace electronics |

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